MI-0179

Evaluation of Resonance Widths from Recycler Magnetic Field Multipoles for Recycler Lattice RRV7

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This note updates information presented in MI-0165 to reflect the newly considered lattice, RRV7. The primary change relative to the lattice RRV6 is that the phase advance/cell has been adjusted slightly to reduce sensitivity to systematic skew quadrupole and octupole components, and the tune point has been moved to (26.275, 25.285). Tables 1-4 and Figure 1 are affected and presented here. It should be noted that these tables now present resonance widths excluding the zeroth harmonic (direct tune vs. amplitude) contributions.

Table 1: Resonance widths as evaluated using expression (4) for a one unit (relative to the dipole) systematic multipole component in the long and short combined function magnets, assuming a beam emittance of 40π mm-mr (normalized).

Resonance Index	l	m	k	δ_R (Long)	δ_R (Short)
1	3	0	79	4.80E-04	4.99E-04
2	0	3	76	2.22E-04	3.48E-04
3	4	0	105	6.10E-04	2.31E-04
4	0	4	101	2.90E-04	2.97E-04
5	5	0	131	4.82E-05	7.40E-06
6	0	5	126	9.50E-05	1.33E-05
7	6	0	158	1.04E-05	2.32E-06
8	0	6	152	1.44E-05	1.15E-05
9	7	0	184	3.70E-06	3.06E-07
10	0	7	177	5.49E-07	8.99E-08
11	8	0	210	9.26E-06	4.59E-07
12	0	8	202	1.96E-06	4.14E-07
13	9	0	237	5.67E-08	5.37E-07
14	0	9	227	2.37E-07	1.07E-07
15	10	0	263	7.87E-08	1.15E-07
16	0	10	253	1.25E-07	8.76E-08

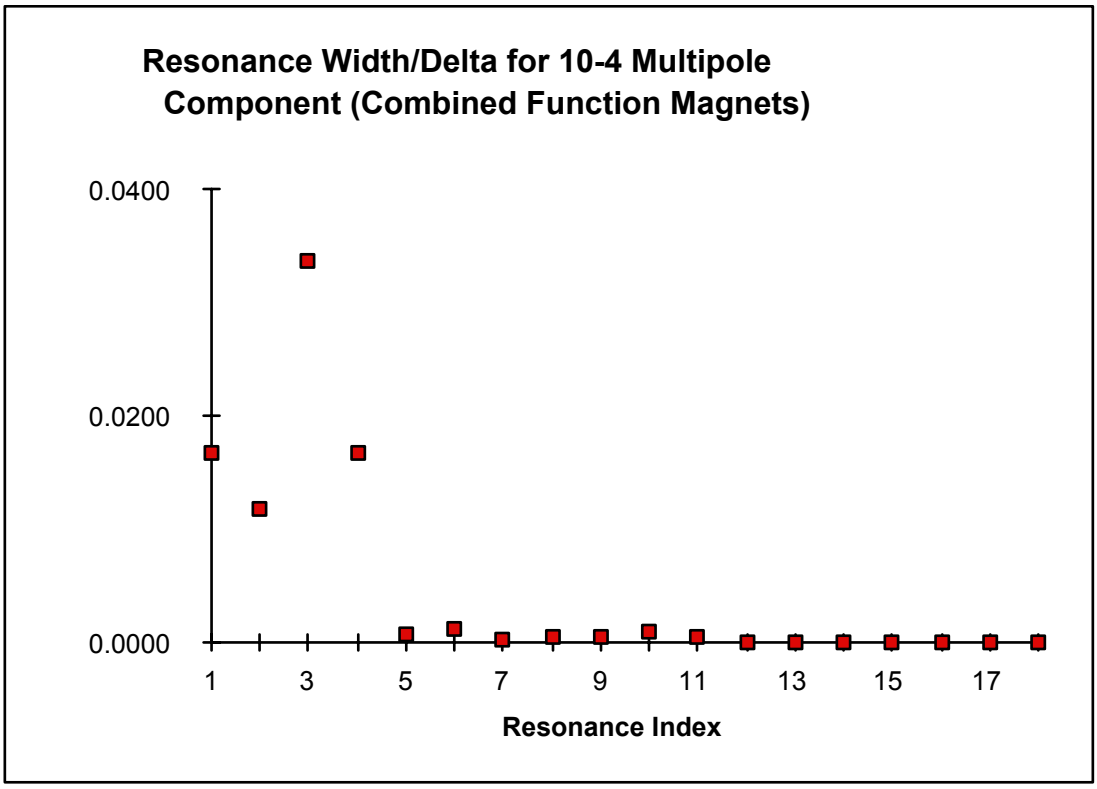

Figure 1: The ratio of the calculated resonance width to the separation of the nominal tune from the resonant tune for a one unit systematic multipole component in the combined function magnets. Resonances from third to tenth order are displayed with indices as indicated in Table 1. An emittance of 40π mm-mr (normalized) is used in this calculation.

Table 2: Resonance widths as evaluated using expression (4) for a one unit (relative to the quadrupole) systematic multipole component in the quadrupole magnets, assuming a beam emittance of 40π mm-mr (normalized).

Resonance Index	l	m	k	δ_R
1	3	0	79	2.06E-05
2	0	3	79	1.56E-05
3	4	0	105	2.46E-05
4	0	4	105	1.96E-05
5	5	0	131	1.88E-06
6	0	5	131	2.29E-06
7	6	0	157	2.01E-07
8	0	6	157	4.27E-07
9	7	0	184	3.04E-07
10	0	7	184	1.85E-08
11	8	0	210	6.80E-08
12	0	8	210	9.80E-08
13	9	0	236	8.36E-09
14	0	9	236	2.03E-08
15	10	0	262	5.26E-09
16	0	10	262	3.46E-09

Table 3: Resonance widths as evaluated using expression (4) for a one unit (relative to the dipole) random multipole component in the long and short combined function magnets, assuming a beam emittance of 40π mm-mr (normalized).

Resonance Index	l	m	k	δ_R (Long)	δ_R (Short)
1	3	0	79	1.06E-03	4.34E-04
2	0	3	79	1.11E-03	4.32E-04
3	4	0	105	3.11E-04	1.21E-04
4	0	4	105	3.31E-04	1.20E-04
5	5	0	131	9.13E-05	3.43E-05
6	0	5	131	9.87E-05	3.39E-05
7	6	0	157	2.68E-05	9.81E-06
8	0	6	157	2.95E-05	9.63E-06
9	7	0	184	7.89E-06	2.82E-06
10	0	7	184	8.80E-06	2.76E-06
11	8	0	210	2.32E-06	8.15E-07
12	0	8	210	2.63E-06	7.94E-07
13	9	0	236	6.81E-07	2.37E-07
14	0	9	236	7.84E-07	2.30E-07
15	10	0	262	2.00E-07	6.90E-08
16	0	10	262	2.34E-07	6.68E-08

Table 4: Resonance widths as evaluated using expression (4) for a one unit (relative to the quadrupole) random multipole component in the quadrupole magnets, assuming a beam emittance of 40π mm-mr (normalized).

Resonance Index	l	m	k	δ_R
1	3	0	79	3.17E-05
2	0	3	79	3.20E-05
3	4	0	105	9.33E-06
4	0	4	105	9.46E-06
5	5	0	131	2.76E-06
6	0	5	131	2.81E-06
7	6	0	157	8.19E-07
8	0	6	157	8.34E-07
9	7	0	184	2.43E-07
10	0	7	184	2.48E-07
11	8	0	210	7.25E-08
12	0	8	210	7.37E-08
13	9	0	236	2.17E-08
14	0	9	236	2.19E-08
15	10	0	262	6.52E-09
16	0	10	262	6.52E-09

Conclusions

Resonance widths are calculated for one unit of designated multipole components for the lattice RRV7. Comparison with RRV6 shows a reduction in 4th order resonance widths of about a factor of five. This reduction is a result of reducing the phase advance /cell from $90^o/90^o$ to $89^o/83^o$ thereby destroying coherent addition of systematic effects.

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